37975

ORIGINAL

26

Exh A-B.

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MICHIGAN

PRECITEC, INC., a Delaware corporation, Plaintiff,	)	JUDGE : O'Meara, John Corbett DECK : S. Division Civil Deck DATE : 08/01/2005 @ 15:38:03 CASE NUMBER : 5:05CV60182 CMP PRECITEC, INC VS AMERICAN TORCH TIP (LE) SI
v.	)	
AMERICAN TORCH TIP, LTD., a Florida corporation, Defendant.	)	MAGISTRATE JUDGE R. STEVEN WHALEN

COMPLAINT FOR PATENT INFRINGEMENT
AND REQUEST FOR JURY TRIAL

Plaintiff, Precitec, Inc., for its Complaint against Defendant, American Torch Tip, Ltd., alleges as follows:

The Parties

1. Plaintiff, Precitec, Inc. ("Precitec"), is a corporation existing under the laws of the state of Delaware, having a place of business at 55820 Grand River Avenue, Suite 250, New Hudson, MI 48165.

2. On information and belief, Defendant American Torch Tip, Ltd. ("American Torch Tip"), is a limited partnership organized under the laws of the state of Florida, and has its principal place of business at 6212 29th Street East, Bradenton, Florida 34203.

Jurisdiction and Venue

3. This is an action for patent infringement under the patent laws of the United States, Title 35, United States Code.

4. This Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a). This Court further has subject matter jurisdiction pursuant to 28 U.S.C. §1332 based on diversity of citizenship because all parties are diverse in citizenship and the amount in controversy exceeds $75,000.00, exclusive of interest and costs.

5. This Court has personal jurisdiction over American Torch pursuant to the Michigan Long Arm Statute, MCL § 600.715.

6. Venue is proper before this Court under 28 U.S.C. §§ 1391 and 1400.

Causes of Action for Patent Infringement

7. On February 6, 1996, United States Patent No. 5,489,888 (the "'888 patent") was duly and legally issued to Manfred Jagiella and Killian Barth, on an invention entitled "Sensor System For Contactless Distance Measuring." The '888 patent was assigned to and is owned by Plaintiff Precitec. A copy of the '888 patent is attached hereto as Exhibit A.

8. On March 19, 1996, United States Patent No. 5,500,504 (the "'504 patent") was duly and legally issued to Manfred Jagiella, et al., on an invention entitled "Nozzle For A Tool For The Working Of Material." The '504 patent was assigned to and is owned by Plaintiff Precitec. A copy of the '504 patent is attached hereto as Exhibit B.

9. Upon information and belief, American Torch has directly infringed, contributorily infringed, and/or actively induced infringement of, the '888 and '504 patents in violation of 35 U.S.C. § 271 by making, using, inducing others to use, offering for sale, and/or selling sensor systems, nozzles, and/or other parts that infringe one or more of the claims of the '888 and '504 patents, both within and outside this judicial district, without authority to do so.

10. Upon information and belief, American Torch's infringement of the '888 and '504 patents has been willful.

11. Plaintiff Precitec has been irreparably damaged and will continue to be irreparably damaged by Defendant's infringement unless this Court enjoins it from continuing its infringement.

Prayer for Relief

Wherefore, Plaintiff Precitec prays for the entry of judgment from this Court that:

(a) United States Patent Nos. 5,489,888 and 5,500,504 were duly and legally issued, and are valid and enforceable;

(b) Defendant American Torch Tip directly and/or contributorily infringed United States Patent Nos. 5,489,888 and 5,500,504 and/or actively induced infringement of United States Patent Nos. 5,489,888 and 5,500,504 by others;

(c) Defendant American Torch Tip be preliminarily and permanently enjoined from engaging in any further acts of infringement of United States Patent Nos. 5,489,888 and 5,500,504;

(d) Plaintiff Precitec be awarded damages adequate to compensate for the infringement by Defendant, pursuant to 35 U.S. C. § 284;

(e) Defendant American Torch Tip's infringement has been willful, thereby entitling Plaintiff Precitec to recover treble damages;

(f) The infringement by Defendant American Torch has been such as to render this action exceptional, and Plaintiff Precitec be awarded reasonable attorney's fees, pursuant to 35 U.S.C. § 285; and

(g) Plaintiff Precitec be awarded such other and further relief as this Court may deem to be appropriate.

Request for Jury Trial

Plaintiff, Precitec, Inc., hereby makes demand for a trial by jury pursuant to Rule 38 of the Federal Rules of Civil Procedure as to all issues of this lawsuit.

RADER, FISHMAN & GRAUER PLLC

Dated: August 1, 2005

By ______________________

R. Terrance Rader (P28747)
Charles A. Bieneman (P66755)
Linda D. Kennedy (P64692)
39533 Woodward Avenue, Suite 140
Bloomfield Hills, Michigan 48304
Tel.: (248) 594-0600
Fax: (248) 594-0610

Attorneys for Plaintiff Precitec, Inc.

R0302793.DOC

A

US005489888A

United States Patent [19]

Jagiella et al.

[11] Patent Number: 5,489,888

[45] Date of Patent: Feb. 6, 1996

[54] SENSOR SYSTEM FOR CONTACTLESS DISTANCE MEASURING

[75] Inventors: Manfred Jagiella, Karlsruhe; Kilian Barth, Forbach, both of Germany

[73] Assignee: precitec GmbH, Gaggenau-Bad Rotenfels, Germany

[21] Appl. No.: 288,534

[22] Filed: Aug. 10, 1994

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 53,034, Apr. 23, 1993, abandoned, which is a continuation-in-part of Ser. No. 788,865, Nov. 7, 1991, abandoned.

[30] Foreign Application Priority Data

Nov. 7, 1990 [DE] Germany 40 35 403.2

[51] Int. Cl.[6] G08B 1/08

[52] U.S. Cl. 340/537; 340/572; 324/662; 324/611

[58] Field of Search 340/537, 572, 340/562; 324/662, 611

[56] References Cited

U.S. PATENT DOCUMENTS

4,295,132	10/1981	Burney	340/562
4,401,949	8/1983	Gold	340/537
4,467,273	8/1984	Rudolph	340/537
4,575,714	3/1986	Rummel	340/568

Primary Examiner—Kenneth A. Wieder
Assistant Examiner—Jose M. Solis
Attorney, Agent, or Firm—Anderson Kill Olick & Oshinsky

[57] ABSTRACT

A sensor system is disclosed for the contactless measuring of the distance between a sensor body and an object. The sensor body contains an identification resistor, the resistance value of which can be interrogated by a control unit which is connected to the sensor body and which is located outside the sensor body. The interrogation makes it possible to determine whether the electrical connection between the control unit and the sensor body exists or is interrupted. If it is interrupted, this can be detected by the control unit in an unambiguous manner due to the missing connection to the identification resistor, and the control unit can generate an alarm signal in order to avoid faulty positioning of the sensor body relative to the object.

12 Claims, 3 Drawing Sheets

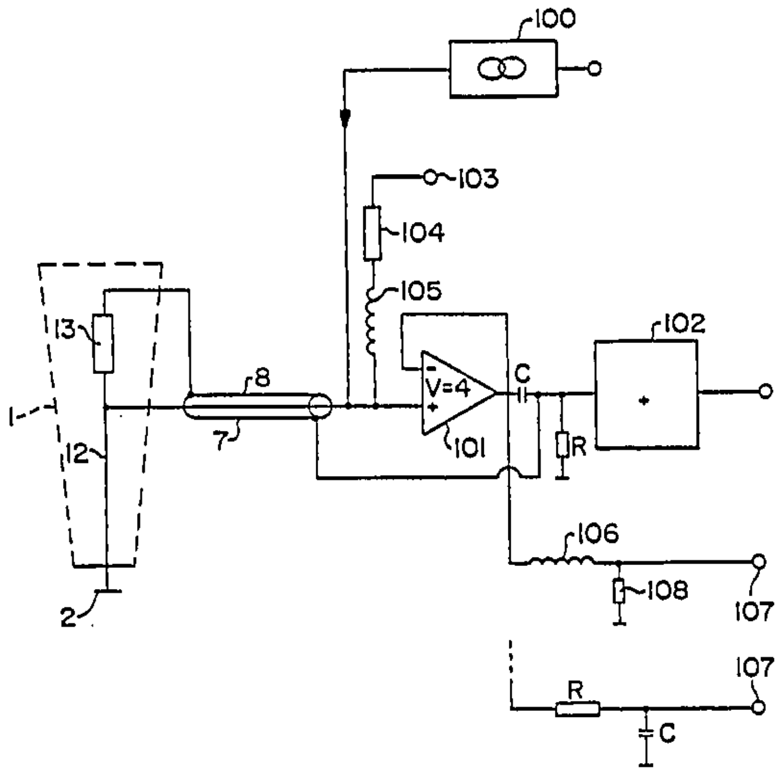


FIG. 1

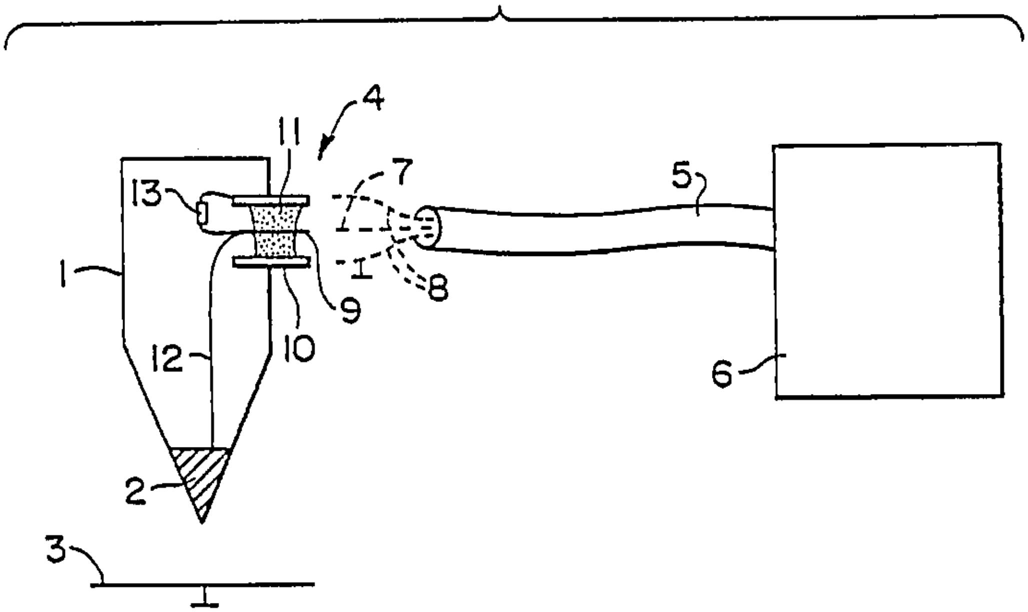


FIG. 2

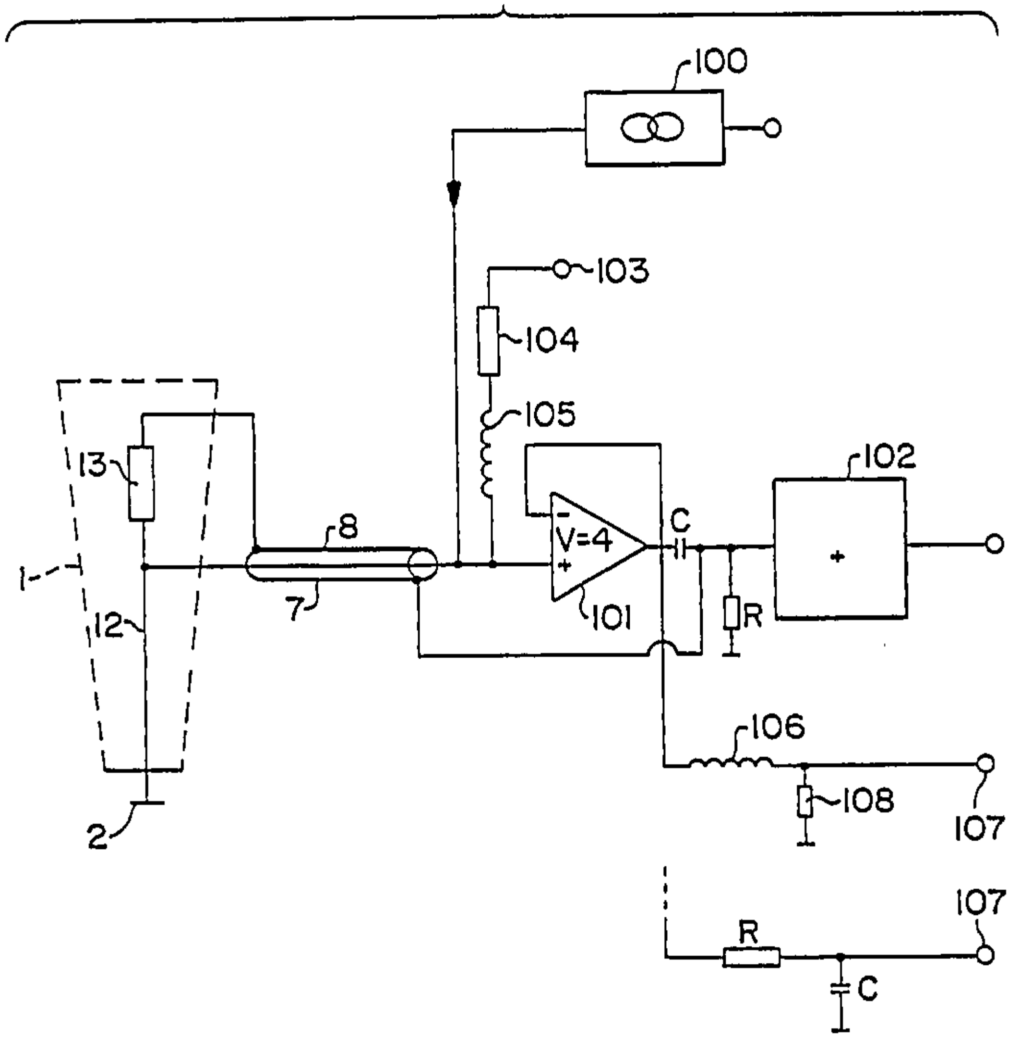
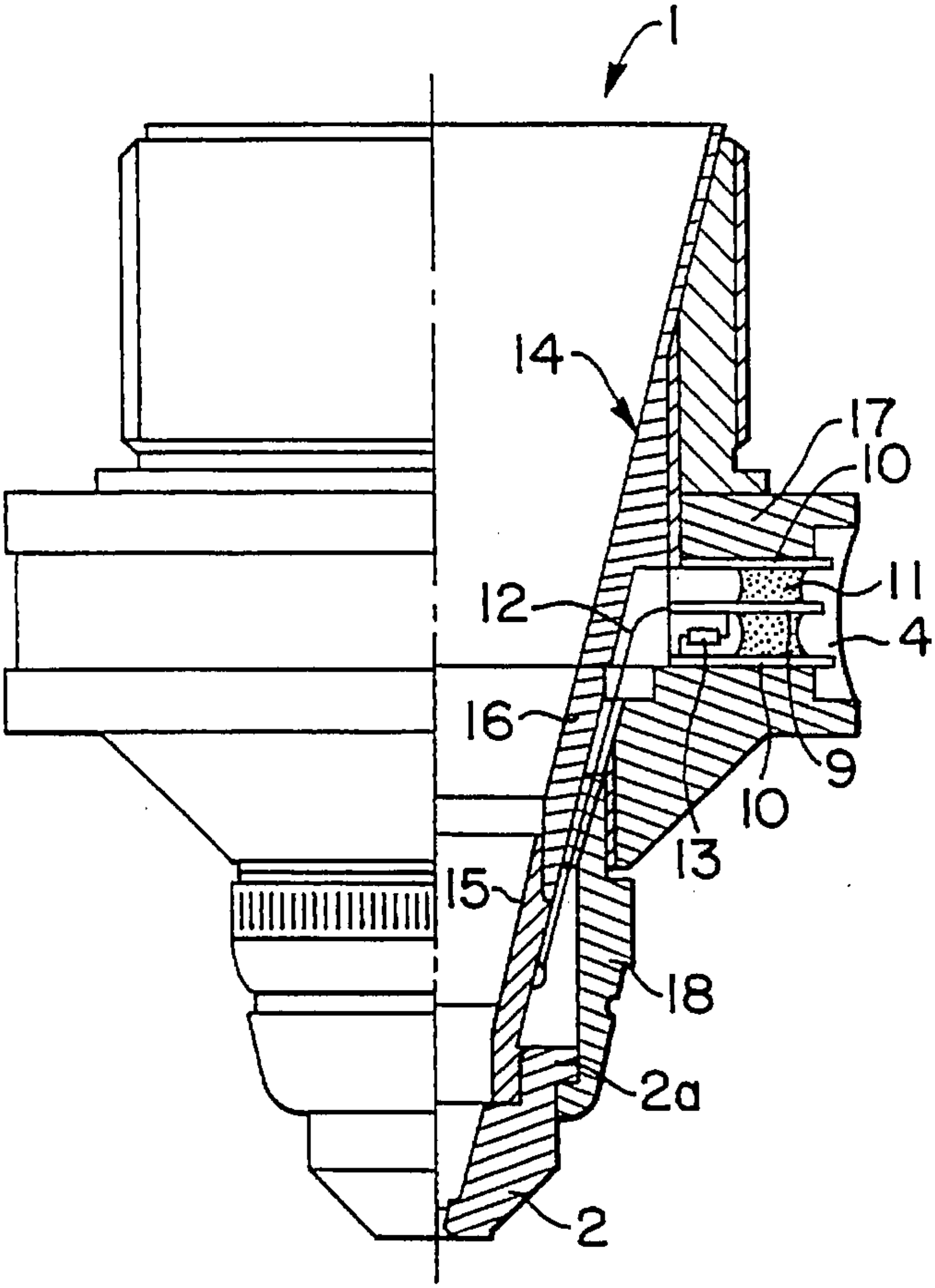


FIG. 3



SENSOR SYSTEM FOR CONTACTLESS DISTANCE MEASURING

This is a continuation-in-part application of U.S. patent application Ser. No. 08/053,034, filed Apr. 23, 1993 now abandoned which is a continuation-in-part application of U.S. patent application Ser. No. 07/788,865, filed Nov. 7, 1991 now abandoned.

FIELD OF THE INVENTION

The present invention relates to a sensor system for contactless distance measuring.

BACKGROUND OF THE INVENTION

Such a sensor system is already part of the prior art and contains a sensor body, a sensor element, arranged at the sensor body for contactlessly measuring the distance between itself and an object, a control unit, for supplying a measuring voltage to the sensor element and for evaluating the measuring voltage for the purpose of determining the distance, and a cable, between the sensor body and the control unit, which is used for transmitting the measuring voltage.

The sensor system is capable of measuring the distance between the sensor element and the object, for example, by capacitive or inductive means, if it is a metallic object, or by optical or acoustical means depending on the system configuration.

If the sensor body of the sensor system is permanently joined to a tool, it is possible to position the tool relative to the object or workpiece in order to be able to machine the workpiece in a suitable manner. Positioning occurs via a control device which receives the measured distance as an actual value and controls the position of the sensor body or the tool by comparing the actual value with a predetermined set tip.

The tool can be, for example, a laser cutting unit for generating a laser beam by means of which the workpiece can be cut or otherwise treated.

At the beginning of the development of sensor systems of this type, not only the sensor element but also a large proportion of the sensor electronics were located inside the sensor body. If, therefore, the sensor body was separated from the control unit by detaching the cable, the control unit was able to detect this unambiguously. In such a case, it generated a warning signal, by means of which the control device for positioning the sensor body was deactivated or stopped.

Integrating the sensor electronics in the sensor body, however, entailed a number of disadvantages. Thus, there was only little space inside the sensor body for installing the electronic components. Installing and calibrating these electronic components was therefore very time-consuming and thus represented a considerable cost factor. Due to the space required for installing the electronic components, the design of the nozzle body was much more elaborate, which also entailed additional costs. Furthermore, integrating the electronic components in the sensor body constituted an obstacle to making the sensor body as slender as possible, which is required, in particular, when the workpiece or object is to be machined three-dimensionally under restricted spatial conditions. There is also the risk of a temperature drift of the actual value or measurement value supplied by the sensor body due to the sensor electronics heating up too much

inside the sensor body which is subject to very great heating when it operates in conjunction with a laser cutting tool and is positioned in the immediate vicinity of the cutting track.

Due to the above disadvantages, the decision was made to arrange the complete sensor electronics at a very great distance from the sensor body. More accurately, the sensor electronics were connected to the sensor body by means of a cable several meters in length, which could also be shielded. The shielding could also be carried out actively, which means that the measurement signal present at the sensor element is applied to the shielding via a capacitor and an amplifier having a gain of V which is equal to 1.

If the sensor electronics are now separated from the sensor body by detaching the cable, however, this leads to a misinterpretation of the actual value by the control unit. In such a case, the control unit detects a very large actual value or distance which is much greater than the normal operating distance, so that it attempts to reduce this distance again. This involves the considerable risk that the sensor element and the sensor body run against the object or workpiece, which could lead to damage.

If, for example, this is a capacitively operating sensor system, the separation of the cable from the sensor body leads to the control unit detecting only a severely reduced measuring capacitance, since the signal line of the cable is now free. However, this effect also rises when the distance between the sensor body of the sensor element and the object or workpiece is much greater than the normal working distance. For this reason, it is not possible to generate an unambiguous warning signal from the measurement signal.

SUMMARY OF THE INVENTION

Accordingly, the present invention is based on the object of developing a sensor system of the last-mentioned type, in which the complete sensor electronics are located outside the sensor body, in such a manner that the control unit can unambiguously detect whether it is separated from the sensor body or not.

Pursuant to this object, and others which will become apparent hereafter, one aspect of the present invention resides in the sensor system having an identification resistor attached to the sensor body. The identification resistor is connected to the cable, and the control unit is constructed so that it supplies an interrogation voltage, which does not influence the measuring voltage, via the cable to the identification resistor for interrogating the resistance value of the identification resistor.

It is possible to determine whether or not the identification resistor, which has a known value, and thus the sensor body, is connected to the control unit by monitoring the magnitude of the interrogation current belonging to the interrogation voltage. Thus, an alarm signal can be generated in a simple manner when, for example, the sensor body and the control unit are separated from one another and no interrogation current flows, in order to avoid a mispositioning of the sensor body or sensor element relative to the object or workpiece.

The control unit can also generate the alarm signal when an interrogated resistance value of the identification resistor does not correspond to a predetermined resistance value or deviates from the latter by a predetermined or threshold value. The interrogated resistance value is calculated from interrogation voltage and interrogation current, and a microprocessor can be used for this purpose. The comparison between the interrogated resistance value and the predeter-

mined resistance value or predetermined threshold is effected by correspondingly existing comparators or by software measures with the aid of a microcomputer.

If an identification resistor with a different resistance value is allocated to each type of sensor body, a sensor identification can be carried out on the basis of the absolute value of the interrogation current. For this purpose, there is a comparator for comparing an interrogated resistance value (current) of the identification resistor with one or more predetermined resistance values (currents). Thus, the interrogated resistance value (current) is compared with the predetermined resistance values (currents) until an appropriate resistance value (current) is found among the predetermined resistance values (currents).

According to a further embodiment of the invention, the control device is constructed in such a manner that it interrogates the resistance value or current of the identification resistor before measuring the distance, or continuously or intermittently during such a measurement. This ensures that no mispositionings between the sensor body or workpiece and object occur during the entire measuring cycle if the cable connection between the sensor body and the control unit should become detached for whatever reason.

According to yet another embodiment of the invention, an alternating voltage is used as the measuring voltage and a direct voltage as the interrogation voltage. Alternating measuring voltages occur, for example, in capacitive and inductive sensor systems, whereas a direct voltage is advantageous as the interrogation voltage, since it can be easily measured for detecting the state of the connection between control unit and sensor body.

According to still another embodiment of the invention, the direct voltage and the alternating measuring voltage are transmitted via the same center conductor of a coaxial cable, the identification resistor being connected between the center conductor and the shielding of the coaxial cable. Thus, only a single cable with two conductors is needed for transmitting the measuring voltage and the interrogation voltage, which cable would also have to be used when transmitting the measuring voltage alone. Thus, no additional wires or possibly other cables are needed to transmitting the interrogation voltage.

This embodiment can be used, for example, in capacitive or inductive sensor systems. In this arrangement, the identification resistor has no influence on the distance measurement value. For example, the measuring capacitance in a capacitive sensor system would be between the center conductor or the core of the coaxial cable and earth (workpiece), whereas the identification resistor is located between the center conductor and the shield of the coaxial cable. Where active shielding is used, the same potential is present at the shield conductor and center conductor so that no current flows through the identification resistor if a correct connection exists between control unit and the sensor body. The direct voltage or interrogation voltage has no influence on the distance measurement value either, since it is only generated from the alternating measuring voltage, for example by using filters and the like. In an inductive sensor system, the identification resistor is connected in series with the sensor element or with the coil arrangement.

In accordance with another embodiment of the invention, the cable between the control unit and the sensor body is a triaxial cable, the alternating measuring voltage being transmitted via the cable core and the identification resistor being connected between the two shields of the triaxial cable.

According to a very advantageous further embodiment of the invention, the identification resistor is arranged in a socket which is attached to the sensor body and to which the cable can be connected via a plug. This type of integration of the identification resistor clearly facilitates the assembly of the sensor body, since the identification resistor can already be connected to the connector socket before it is inserted into the sensor body. Since the connector socket is permanently connected to the sensor body, the identification resistor is thus also attached to the sensor body. Where an inductive sensor system is used, the identification resistor can be arranged in the connector socket in such a manner that it is located electrically in series between two center conductor ends of the connector socket. The insulator then also accommodates the identification resistor.

A micro-metal film resistor (micromelf resistor) is preferably used as the identification resistor, which has particularly small dimensions and can therefore be integrated in the connector socket in a very simple manner.

As already mentioned, the sensor system can operate capacitively, so that the sensor element is a capacitive element and virtually represents one electrode of a capacitor, the other electrode of which is formed by the object or workpiece.

However, the sensor system can also operate inductively, so that the sensor element is an inductive element. For example, an induction coil or a group of induction coils can be used as the inductive element, the inductance of which is changed as a function of the distance from the object or workpiece.

The respective measurement signals contain information on the change in capacitance or inductance so that the control unit can determine the distance of the sensor body or of the sensor element from the object or workpiece on the basis of this information.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the Drawings:

FIG. 1 shows a basic circuit diagram of a capacitively operating sensor system pursuant to the present invention with a coaxial cable between sensor body and control unit;

FIG. 2 shows a circuit which corresponds to the circuit diagram of FIG. 1 with which an interrogating d.c. voltage and a measurement alternating voltage can be transmitted via one and the same conductor; and

FIG. 3 shows a sensor body for capacitive distance measuring, shown partially as an axial section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The sensor system shown in FIG. 1, which operates capacitively, contains a sensor body 1, at the tip of which a sensor element 2 is arranged. The sensor element 2 consists of electrically conductive material, for example of copper, and is electrically insulated from the sensor body 1. A workpiece has the reference symbol 3 and is connected to

earth potential. The sensor element 2 and the workpiece 3 thus form a capacitor, the capacitance of which is a measure of the distance between the two elements 2 and 3.

A coaxial connector socket 4 is located in a side wall of the sensor body 1 and is electrically insulated from the latter. A coaxial plug, not shown, which is connected to one end of a coaxial cable 5, the other end of which is connected to a control unit 6, can be connected from the outside to the coaxial connector socket 4. The center conductor (core) of the coaxial cable 5 carries the reference symbol 7, while the shielding of the coaxial cable 5 carries the reference symbol 8. The shielding 8 is connected, for example, to earth potential.

The coaxial connector socket 4 exhibits a center conductor 9, with respect to which an outer ring conductor 10 is coaxially arranged. Between the center conductor 9 and the outer ring conductor 10 an insulating material 11 is located. The outer ring conductor 10 is electrically in contact with the sensor body 1.

At the output end, the center conductor 9 can be connected via the coaxial plug, not shown, to the core 7 and the outer ring conductor 10 can be connected to the shield 8 of the coaxial cable 5.

On the other hand, the center conductor 9 is electrically connected to the sensor element 2 via a shielded line 12 in the interior of the sensor body 1. The center conductor 9 is electrically connected to the outer ring conductor 10 of the coaxial connector socket 4 via an identification resistor 13, also in the interior of the sensor body 1. The identification resistor 13 exhibits a known or defined resistance value which changes only very slightly in the temperature range in question of the sensor body 1 and thus is to be considered virtually constant.

To measure the distance between the sensor element 2 and the workpiece 3, an alternating measurement signal, which is evaluated in a conventional manner, is transmitted from the control unit 6 via the center conductor 7 of the coaxial cable 5, the center conductor 9 and the shielded line 12 to the sensor element 2. For example, if it has a fixed frequency, its amplitude can be used for distance determination.

In addition, the control unit applies a direct voltage as an interrogation voltage to the identification resistor 13 via the center conductor 7 of the coaxial cable 5 and the center conductor 9 in order to determine, by measuring the resistance value of this identification resistor 13, whether the control unit 6 is connected to the sensor body 1 via the coaxial cable 5.

As already mentioned initially, the direct voltage and the alternating measurement signal do not mutually influence one another, since the measuring capacitance is located between the center conductor 7 or the center conductor 9 and earth or the workpiece 3, whereas the identification resistor is located between the center conductor 7 or the center conductor 9 and the shield 8 or the outer ring conductor 10. Since the distance measurement value is only generated from the alternating measuring voltage which can be filtered appropriately, it is not influenced by the direct voltage or interrogation voltage present on the center conductor 7.

If the control unit 6 is electrically separated from the sensor body 1 because, for example, the coaxial plug, not shown, has been detached from the coaxial connector socket 4, no direct current flows via the center conductor 7 to the shield 8 because of the direct or interrogation voltage applied to the center conductor 7. The control unit 6 detects this condition by measuring the direct current and generates an alarm signal which deactivates or stops the control device for positioning the sensor body 1 relative to the workpiece 3. The sensor body 1 can thus not be mistakenly driven against the workpiece 3.

If, in contrast, the control unit 6 and the sensor body 1 are electrically connected to one another via the coaxial cable 5, a direct current flows from the center conductor 7 to the shield 8, in accordance with the resistance value of the identification resistor 13 due to the interrogation voltage applied to the center conductor 7, so that the control unit 6 does not generate a warning signal in this case and, in addition, can recognize the type of sensor body 1 by means of the measured direct current value. Depending on the sensor body type, an identification resistor 13 having a different resistance value can be used. For example, a suitable control program for positioning the sensor body 1 relative to the workpiece 3 can then be selected independently of the type of sensor body 1.

With reference to FIG. 1, the sensor body 1 is connected with the control unit 6 via a coaxial cable 5 which, however, can also be a shielded cable. Both the sensor element 2 and the characteristic resistor 13 are connected with the center conductor 7. The characteristic resistor 13 is located between the center conductor 7 and the shield conductor 8 of the cable 5.

It is important to the invention that both the measurement voltage for the capacitive distance measurement and the interrogating voltage for the characteristic resistor 13 are transmitted via the same center conductor 7. The measurement voltage is an alternating voltage, while the interrogating voltage is a d.c. voltage which is superimposed on the alternating voltage.

Another very important feature in FIG. 1 consists in that the shield conductor 8 of the cable 5 is connected to an active shield potential. The active shield potential is obtained in that the measurement voltage, connected to the center conductor 7, is guided to the shield conductor 8 via an amplifier having an amplification factor of V which is greater than or equal to 1. Thus, the alternating measurement voltage has the same phase at the center conductor 7 and at the shield conductor 8 so that no a.c. current passes through the interrogating resistor 13. Rather, only the capacitive distance measurement is carried out with the aid of the alternating voltage, wherein the alternating voltage reaches the sensor element 2 via the conductor 12.

It should be pointed out that no alternating current passes through the interrogating resistor 13 due to the active shielding. Rather, the interrogating resistor 13 is supplied with a d.c. voltage so that an interrogating current d.c. voltage passes through the resistor 13. The interrogating current d.c. current, however, does not pass through the sensor element 2 since the sensor element 2 is separated from the workpiece 3.

Therefore, the substantial characteristic features of the present invention consist of the features that the characteristic resistor 13 and the sensor electrode 2 are connected with the same center conductor 7; an alternating measurement voltage as well as an interrogating d.c. voltage are transmitted via the center conductor 7; and an active shield potential is connected to the shield conductor 8 of the cable 5.

The identification resistor 13, is preferably a micro-metal film resistor which is very small and can therefore be integrated directly in the interior of the connector socket.

FIG. 2 illustrates another circuit with which the interrogating d.c. voltage and the measurement alternating voltage can be transmitted via one and the same conductor. The

circuit corresponds to that shown in FIG. 1. An a.c. source 100 whose output is connected with the conductor 7 serves to generate the alternating measurement voltage. The alternating measurement voltage accordingly reaches the sensor element 2 via conductor 7 and conductor 12. It is altered by the capacitance $C_{measurement}$ so that a measurement signal is located at the (+) input of the amplifier 101. The output of the amplifier 101 is guided to a rectifier 102 with a low-pass filter via a decoupling capacitor (filter capacitor) C. The distance signal $U_{distance}$ can be taken off at the output of the latter.

The amplifier 101 has an amplification factor V which is greater than or equal to 1 and the output of the amplifier 101 is likewise guided to the shield conductor 8 via the decoupling capacitor C to supply the shield conductor 8 with active shield potential in this way. It is also important to note that it is possible for the amplification factor V of the amplifier 101 to be less than 1. An amplification factor of slightly less than 1, such as, for example, 0.95 is also envisioned and is possible with the circuitry of the present invention.

The interrogating d.c. voltage for the characteristic resistance 13 is generated by means of a d.c. voltage source 103 and given to the center conductor 7 via a resistor 104 and a coil 105. The coil 105 serves to block alternating currents and is connected in series with the resistor 104. The coil may be omitted in case of a high stability of the d.c. voltage generated by the d.c. voltage source 103. In other words, the interrogating d.c. current from the d.c. current source 103 passes through the elements 104 and 105 to the center conductor 7 and through the characteristic resistor 13 and the shield conductor 8 back to a line between the decoupling capacitor C and the input of the rectifier 102. A coil 106 connected to the output of the amplifier 101 serves to block alternating currents. The other end of the coil 106 is connected with an output 107 at which the characteristic voltage $V_{characteristic}$ can be taken off, specifically via a resistor 108. An RC low-pass filter can be used instead of the elements 106, 108.

Thus, the characteristic features of the invention are also realized in this case, the alternating voltage from the a.c. source 100 and the d.c. voltage from the d.c. source 103 being supplied to the same conductor, namely the center conductor 7 of the shielded cable. Its shielding 8 receives active sensor potential, specifically from the output of the amplifier 101 via the decoupling capacitor C, so that both conductors 7 and 8 are connected to the same alternating potential. Accordingly, no alternating current can pass through the resistor 13. Only the interrogating current d.c. which produced a corresponding voltage drop at the resistor 108 passes through this resistor 13. The voltage at the output 107 can then be compared in a known manner with other voltage values in order thereby to determine the magnitude of the resistance 13 when the magnitude of the interrogating current of the current source 103 is known.

FIG. 3 shows such a case by means of the example of a capacitive sensor body.

The sensor body 1 contains a sensor element 2 which consists of electrically conductive material and has a nozzle 14 at the tip. The nozzle 14 contains a front area 15 of electrically conductive material which is in electrical contact with the sensor element 2. However, the front area 15 is electrically insulated from the remaining area 16 of the nozzle 14, for example, by a suitable ceramic adhesive by means of which the parts 15 and 16 are permanently joined to one another. The area 16 also consists of electrically

conductive material and has a shielding function. An electrically conductive sleeve 17 concentrically surrounds the nozzle and is connected to it. A cap nut 18 of electrically conductive material, which encircles a flange 2*a* of the sensor element 2 and can be screwed into the sleeve 17 is used for holding the sensor element 2 on the tip of the front area 15. The cap nut 18 is electrically insulated in the area where it is connected to the sensor element 2 or the outer flange 2*a*, so that the sensor element 2 and the cap nut 18 do not have any electrical contact with one another. In contrast, the cap nut 18 is electrically connected to the sleeve 17 and, via the latter, electrically connected to the area 16 of the nozzle 14.

In the side area of the sleeve 17, the coaxial connector socket 4 is screwed in, to which the coaxial cable 5 of FIG. 1 can be connected via the coaxial plug, not shown. The outer ring conductor 10 of the coaxial connector socket 4 is in electrical contact with the sleeve 17 and is at shield potential. The shield potential is either earth potential or, in the case of active shielding, the measuring potential. The center conductor 9 of the coaxial connector socket 4 is electrically insulated from the outer ring conductor 10 by means of an insulator 11, the center conductor 9 being electrically connected to the front area 15 of the nozzle 14 via a shielded line 12 in the interior of the sensor body 1. The alternating measurement signal supplied by the control unit 6 thus passes via the center conductor 9 and the shielded line 12 to the front area 15 and from there to the sensor element 2. The elements 16, 17 and 18 are also used as shielding elements.

As can be seen in FIG. 3, an identification resistor 13 is located in the interior of the hollow-cylindrically constructed outer ring conductor 10 and is thus protected against damage. One terminal of the identification resistor 13 is connected to the center conductor 9, while the other terminal of the identification resistor 13 is connected to the outer ring conductor 10. The identification resistor 13 can be integrated in the coaxial connector socket 4 even before the latter is screwed into the sleeve 17. If, in contrast, the insulator 11 completely fills the remaining hollow space inside the outer ring conductor 10, the identification resistor 13 can come to be located, instead of in the interior of the outer ring conductor 10, also at its front end and on the insulator 11. In other respects, the mode of operation of the identification resistor 13 in FIG. 3 corresponds to the mode of operation of the identification resistor 13 in FIG. 1.

While the invention has been illustrated and described as embodied in a sensor system for contactless distance measuring, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention. Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of the prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention. What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

What is claimed is:

1. A sensor system, for capacitive distance measurement, comprising:

a sensor body;

a sensor element arranged at said sensor body for contactlessly measuring a distance between said sensor element and an object;

a control means for supplying a measuring voltage to said sensor element and for evaluating said measuring voltage for the purpose of determining said distance;

a cable between said sensor body and said control means which is used for transmitting said measuring voltage; and

an identification resistor having a resistance value and being attached to said sensor body and connected to said cable, said control means being constructed so that it supplies an interrogation voltage, which does not influence said measuring voltage, via said cable to said identification resistor for interrogating said resistance value of said identification resistor,

wherein said measuring voltage is an alternating voltage and said interrogation voltage is a direct voltage, and further wherein said cable is a coaxial cable having a center conductor and a shield conductor, and wherein the direct voltage and the alternating measuring voltage are transmitted via said center conductor of said coaxial cable and said identification resistor is connected between said center conductor and said shield conductor of said coaxial cable, and wherein said shield conductor is connected to an active shield potential obtained in that the measuring voltage is guided to said shield conductor via an amplifier.

2. The sensor system of claim 1, wherein said control means includes a comparator for comparing an interrogated resistance value of said identification resistor with at least one predetermined resistance value.

3. The sensor system of claim 2, wherein said control means generates an alarm signal when said interrogated resistance value does not correspond to at least one of a predetermined resistance value and is above a predetermined threshold.

4. The sensor system of claim 1, wherein said control means interrogates said resistance value of said identification resistor before measuring said distance.

5. The sensor system of claim 1, wherein said control means interrogates said resistance value of said identification resistor continuously during the measurement.

6. The sensor system of claim 1, wherein said control means interrogates said resistance value of said identification resistor intermittently during the measurement.

7. The sensor system of claim 1, wherein said identification resistor is arranged in a connector socket which is attached to said sensor body and to which said cable is connectable by a plug.

8. The sensor system of claim 1, wherein said identification resistor is a micro-metal film resistor.

9. The sensor system of claim 1, wherein said sensor element is a capacitive element.

10. The sensor system of claim 1, wherein said connector socket has a center conductor, and wherein said identification resistor is located between two ends of said connector socket center conductor.

11. The sensor system of claim 1, wherein said amplifier has an amplification factor which is greater than or equal to 1.0.

12. The sensor system of claim 1, wherein said amplifier has an amplification factor which is less than 1.0.

* * * * *

B.

US005500504A

...ted States Patent [19]

Jagiella et al.

[11] Patent Number: 5,500,504

[45] Date of Patent: Mar. 19, 1996

[54] NOZZLE FOR A TOOL FOR THE WORKING OF MATERIAL

[75] Inventors: Manfred Jagiella, Karlsruhe; Wolf Wiesemann, Gaggenau; Peter Schubert, Neukirch; Michael Holzmann, Rastatt; Georg Spörl, Gaggenau, all of Germany

[73] Assignee: C. A. Weidmüller GmbH & Co., Detmold, Germany

[21] Appl. No.: 788,864

[22] Filed: Nov. 7, 1991

[30] Foreign Application Priority Data

Nov. 7, 1990	[DE]	Germany	40 35 403.2
Nov. 7, 1990	[DE]	Germany	40 35 404.0
Jun. 11, 1991	[DE]	Germany	41 19 244.3
Oct. 7, 1991	[DE]	Germany	41 33 198.2

[51] Int. Cl.^{6} B23K 26/14

[52] U.S. Cl. 219/121.67; 219/121.7

[58] Field of Search 219/121.6, 121.63, 219/121.65, 121.67, 121.68, 121.7, 121.79, 121.11, 121.78, 121.84

[56] References Cited

U.S. PATENT DOCUMENTS

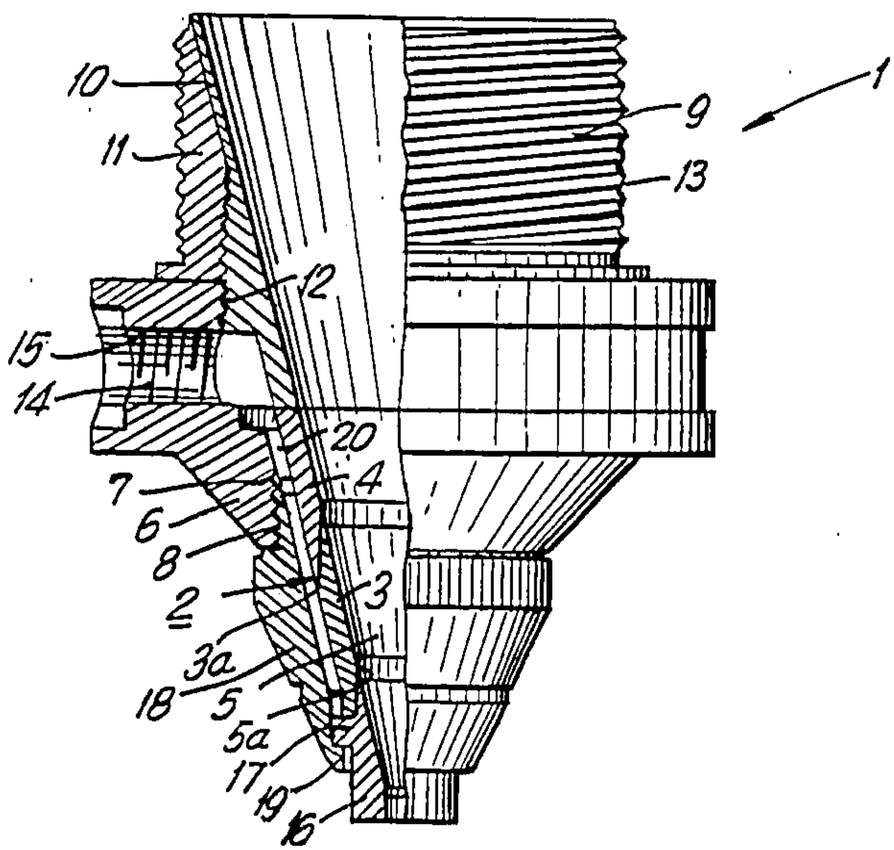
4,298,784	11/1981	Schmall	219/124.02
4,467,171	8/1984	Ramos	219/121.67
4,794,222	12/1988	Funayama et al.	219/121.78
5,128,508	7/1992	Klingel	219/121.72
5,192,847	3/1993	Jagiella et al.	219/121.6

Primary Examiner—Tu Hoang
Attorney, Agent, or Firm—Anderson Kill Olick & Oshinsky

[57] ABSTRACT

A nozzle for a tool for the working of material and having a nozzle body which is composed of electrically conducting material and carries a nozzle electrode in its tip region with the tip region of the nozzle body and the remaining region of the nozzle body being formed by separate parts which are connected to one another and electrically insulated from one another, the nozzle electrode being in direct electrical contact with the tip region.

29 Claims, 2 Drawing Sheets



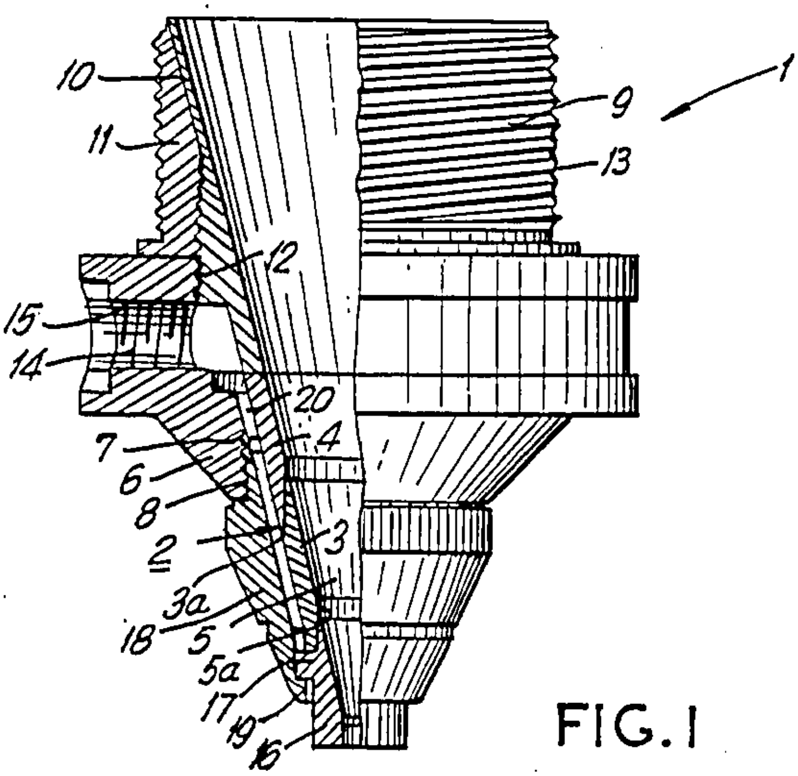

1
10
9
11
13
12
15
14
20
7
4
6
8
2
3
3a
18
5
5a
17
19
16

FIG. 1

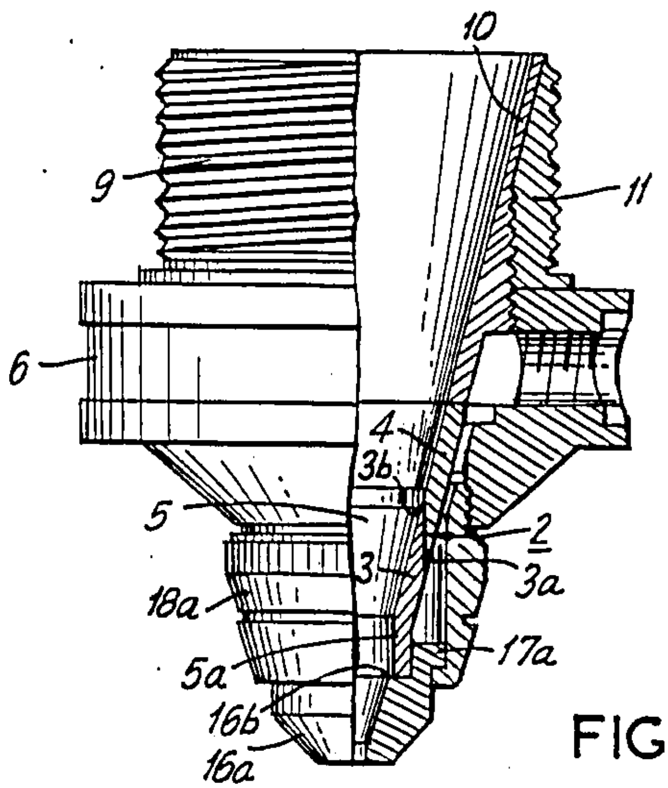

10
9
11
6
4
3b
5
2
3
3a
18a
17a
5a
16b
16a

FIG. 2

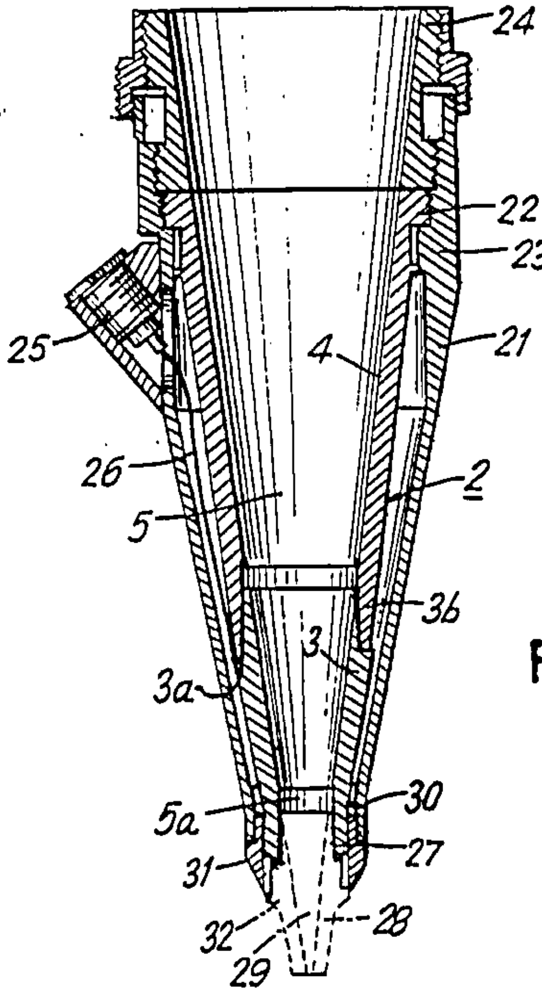

24
22
23
21
25
4
26
2
5
3b
3
3a
30
5a
27
31
28
32
29

FIG. 3

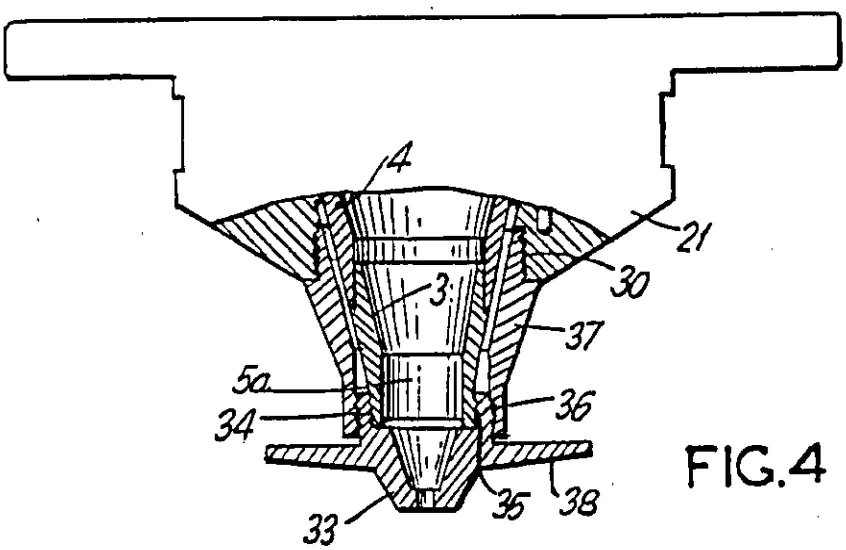

4
21
30
3
37
5a
36
34
35
38
33

FIG. 4

NOZZLE FOR A TOOL FOR THE WORKING OF MATERIAL

BACKGROUND OF THE INVENTION

The invention relates to a nozzle for a tool for the working of material.

A nozzle of this kind has already been disclosed in German Patent Application P 40 28 338.0. This nozzle has a nozzle body which is composed of an electrically conducting material and, in its tip region, carries a nozzle electrode. The nozzle electrode is held in the tip with the aid of a cap element which accommodates the electrode. The cap element is composed of electrically conducting material and is electrically insulated from the nozzle electrode.

The nozzle can be used, for example, for working metallic workpieces with the aid of laser radiation, for example for cutting a workpiece with the aid of a high-power laser beam. The laser beam here passes through a channel in the center of the nozzle, said channel also leading through the nozzle electrode.

The nozzle electrode is used for capacitive clearance measurement in order to guide the nozzle relative to the workpiece. For this purpose, a sensor signal which is supplied by the nozzle electrode and appears at the outlet of a plug socket connected to the nozzle body undergoes further processing. In the conventional nozzle, the nozzle electrode is positioned in an insulating body which is of hollow-cylindrical design and, for its part, is arranged in the interior of the tip region of the nozzle body. This insulating body can, for example, be composed of ceramic. Due to the wall thickness of the insulating body, however, the nozzle has a relatively large diameter in its tip region. Particularly in the case of an insulating body of ceramic, it is not possible arbitrarily to reduce the wall thickness further due to reasons connected with production and stability, with the result that the nozzle is relatively thick in its tip region. It cannot be used therefore in some areas of application in which as slim a nozzle shape as possible is demanded, for example in the three-dimensional working of motor-vehicle parts, and the like.

On the other hand, due to the insulating body used, only poor cooling of the nozzle electrode is possible since it prevents dissipation of the heat towards the nozzle body. Particularly in the case of prolonged operation or in the case of operation at high power, the nozzle electrode may therefore heat up to an impermissibly high degree.

The use of an insulating body for positioning the nozzle electrode furthermore increases the cost of the nozzle construction, particularly if high requirements are made of the heat resistance of the insulating body and, for this purpose, it is manufactured from ceramic.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to further develop a nozzle of the type previously stated in such a way that it can be of slimmer design in its tip region, ensure better cooling of the nozzle electrode and can be manufactured more cheaply.

Pursuant to this object, and others which will become apparent hereafter, one aspect of the present invention resides in a nozzle in which the tip region of the nozzle body and its remaining region are formed by separate parts. The nozzle electrode is in direct contact with the tip region and

the tip region is electrically insulated from the remaining region of the nozzle body.

By means of this construction it is possible to achieve a very slim nozzle shape since the tip region of the nozzle body can be of a relatively thin and slim design and the nozzle electrode can be secured directly on the tip region, i.e. without the interposition of an insulating body between the nozzle body and the nozzle electrode. Since the nozzle electrode no longer rests in an insulating body, its heat can also be dissipated better to the nozzle body, virtually the entire nozzle thus serving as a cooling element. The heat thus flows from the nozzle electrode, via the tip region, to the remaining region of the nozzle body, the insulation between the tip region and the remaining region of the nozzle body being designed in such a way that the flow of heat is not appreciably reduced thereby. The selected thickness of the insulation between the tip region and the remaining region of the nozzle body can be very small since, in practice, it is not subjected to very high mechanical loads. On the other hand, the contact area in this region between the tip region and the remaining region of the nozzle body is relatively large, leading to efficient heat dissipation.

In comparison to the conventional nozzle, the nozzle according to the invention can also be manufactured at a more favorable cost since it is possible to dispense with the manufacture and assembly of the insulating body for accommodating the nozzle electrode.

The tip region and the remaining region of the nozzle body can, for example, be firmly connected to one another via an electrically insulating adhesive, the adhesive used being, for example, a ceramic adhesive.

It is also possible to provide the remaining region of the nozzle body and/or the tip region with an electrically insulating surface coating, at least in their connection region. This surface coating provided for the electrical insulation of both parts can, for example, be an oxide layer if the remaining region of the nozzle body and the tip region are composed of oxidizable, electrically conducting materials. The remaining region of the nozzle body can, for example, be manufactured from aluminum and can have an anodized layer as the surface coating. The same can apply to the tip region, although this can also be manufactured from some other conducting material, for example brass.

For the purpose of insulating the tip region from the remaining region of the nozzle body, the surface coating can also be composed of some other suitable material, for example of Teflon or a vapor-deposited ceramic material.

Both parts are then connected firmly to one another, for example by means of a suitable adhesive after having been inserted into one another.

It is also possible to connect the remaining region of the nozzle body and the tip region to one another via an electrically insulating nozzle-body part, for example via a metal ring provided with an insulator. However, this ring can also be composed exclusively of insulating material if dissipation of the heat from the nozzle electrode is not particularly important.

The remaining region of the nozzle body, the tip region and, if required, the nozzle-body part are designed in such a way that, when fitted together, a cone-shaped nozzle body is obtained.

The remaining region, the tip region and, if required, the nozzle-body part can advantageously have steps at their circumferential edges for the purpose in each case of their mutual positioning in the axial direction. These parts can then be inserted into one another telescopically in the end region, leading to a particularly stable connection.

According to a further embodiment of the invention, the nozzle electrode is held with the aid of a cap element which accommodates it, which is composed of electrically conducting material and which is electrically insulated from the nozzle electrode. Rapid exchange of the nozzle electrode is thereby possible, making it possible to shorten stoppage times of installations in which the nozzle is used.

According to another embodiment of the invention, the cap element can be connected to a sleeve of electrically conducting material which surrounds the nozzle body and via which the cap element is in electrical contact with the remaining region of the nozzle body.

Thus, in the nozzle according to the invention, the nozzle electrode and the tip region, on the one hand, are electrically connected to one another while, on the other hand, the cap element, the sleeve and the remaining region of the nozzle body are electrically connected to one another. The last-mentioned subassembly forms a shield for the first-mentioned subassembly and, at the same time, a shield for a signal lead which, starting from the tip region, passes between the sleeve and the remaining region of the nozzle body, more precisely to a connecting socket in the side region of the nozzle.

However, it is not absolutely necessary to use a sleeve of the stated type. The cap element can also come into direct engagement with the remaining region of the nozzle body and in the process ensure shielding of the nozzle electrode and the signal lead.

According to still another embodiment of the invention, the nozzle electrode can be inserted into the tip region and can rest on the end face of the latter by means of an outer circumferential flange. A particularly slim nozzle shape can thereby be achieved. However, it is also possible for the nozzle electrode to engage around the tip region with a circumferential flange and rest on the end face of the latter by means of an inner step. In comparison with the conventional nozzle, a slimmer nozzle construction can be achieved in each case since the insulating body between the nozzle electrode and the tip region is dispensed with. The cap element then pulls the nozzle electrode against the tip region of the nozzle body via the circumferential flange.

According to yet another advantageous embodiment, the nozzle electrode is of conical design on the outside. A cap element of corresponding conical design on the inside can then pull the nozzle electrode against the tip region without the necessity for the presence of an outer circumferential flange on the nozzle electrode. The cap element is electrically insulated from the nozzle electrode, for example by an insulating layer on the cap element, the layer being present at least in the region of contact with the nozzle electrode.

The insulating layer, which is a surface coating, can, for example, be an oxide, anodized or ceramic coating. The cap element is preferably designed as a cap nut, which can be screwed internally or externally to the sleeve.

According to another, very advantageous embodiment of the invention, the nozzle body is surrounded by a sleeve of electrically conducting material which lies at a distance from it and is in electrical contact with the remaining region of the nozzle body. The sleeve carries at its tip a removable shielding sleeve which is in electrical contact with the sleeve and at least partially surrounds the nozzle electrode, is composed of electrically conducting material and is electrically insulated from the nozzle electrode. Furthermore, the nozzle electrode is connected directly to the tip region of the nozzle body.

Here, a non-positive connection between the nozzle electrode and the tip region of the nozzle body is thus effected

directly without the necessity for further holding devices. The nozzle electrode can advantageously be screwed to the tip region of the nozzle body. In this arrangement, the nozzle electrode can be screwed into the tip region of the nozzle body. However, the nozzle electrode and the tip region of the nozzle body can also be connected to one another by means of a bayonet catch or by means of a suitably designed lock-in/snap-in catch. In this arrangement, the shielding sleeve partially covers the nozzle electrode or covers it as far as the electrode tip.

According to a further embodiment of the invention, the nozzle body is surrounded by a sleeve of electrically conducting material which lies at a distance from the sleeve and is in electrical contact with the remaining region of the nozzle body. The sleeve carries at its tip a removable shielding sleeve which is in electrical contact with the sleeve and at least partially surrounds the nozzle electrode, is composed of electrically conducting material and is electrically insulated from the nozzle electrode. The nozzle electrode, with a foot part, is introducible from outside into the shielding sleeve and connectable to the shielding sleeve.

The foot part can preferably be screwed into the shielding sleeve, more precisely until the foot part or the nozzle electrode comes into electrical contact with the tip region of the nozzle body. In the region of the screw thread, the nozzle electrode and the shielding sleeve are electrically insulated from one another, for example by a suitable surface coating, which can, for example, be on the shielding sleeve.

It is very advantageous in the last-mentioned nozzles according to the invention that the nozzle electrode can be removed readily from the tip region of the nozzle body without other components having to be detached for this purpose. As a result, the nozzle electrode can be exchanged very simply and in a relatively short time if this is desired.

The shielding sleeve can preferably be screwed to the above-mentioned sleeve, it being possible, for example, for the shielding sleeve to be screwed into an internal thread of the sleeve.

The shielding sleeve and the nozzle electrode are at a different potential, making it necessary to electrically insulate them from one another. For this purpose, the shielding sleeve can bear an electrically insulating surface coating, particularly where a contact with the nozzle electrode occurs. The surface coating can, for example, be an oxide, anodized or ceramic layer. The shielding sleeve is preferably composed of aluminum. The electrically insulating surface coating of the shielding sleeve can also cover the entire surface of the shielding sleeve, with the exception of the region of connection between the shielding sleeve and the sleeve since an electrical contact must be established between these two elements.

According to another further embodiment of the invention, the nozzle electrode has a circumferential bead which covers the frontal edge of the shielding sleeve. In this way, the frontal edge of the shielding sleeve is protected from damage which can occur, for example, due to hot material spatter which forms during the working or welding operation. If metal spatter does nevertheless fall into the region between the nozzle electrode and the shielding sleeve, this spatter does not cause a short circuit since the shielding sleeve bears an electrically insulating surface coating at least in this region.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with addi-

tional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows, on the left, an axial section and, on the right, a side view of a nozzle in accordance with a first embodiment of the invention, in which the nozzle electrode is held by a cap nut and is inserted into the tip region,

FIG. 2 shows, on the left, a side view and, on the right, an axial section of a nozzle in accordance with a second embodiment of the invention, in which the nozzle electrode is held by a cap nut and is placed on the tip region,

FIG. 3 shows an axial section through a nozzle in accordance with a third illustrative embodiment of the invention, with a nozzle electrode screwed directly into the tip region, and

FIG. 4 shows an axial section through a nozzle in accordance with a fourth illustrative embodiment of the invention, with a nozzle electrode screwed into the shielding sleeve.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A nozzle 1 in accordance with FIG. 1 has a nozzle body 2, to which belongs a tip region 3 and a remaining region 4 of the nozzle body 2. The nozzle body 2 is of conical design, both on the outside and on the inside. Only the free end of the tip region 3 has a hollow cylinder shape, with the result that a nozzle channel 5 present in the interior of the nozzle body 2 tapers conically towards the tip of the nozzle 1 and finally makes a transition into a cylindrical channel *5a*. The rear part of the cone forms the remaining region 4, while the front part of the cone forms the tip region 3.

As can be seen from FIG. 1, the tip region 3 and the remaining region 4 of the nozzle body 2 are inserted into and fit in one another and are insulated from one another, with the result that there is no electrically conducting connection between them. A step *3a* on the outer circumferential edge of the tip region 3 serves for the axial positioning of the remaining region 4. The end face of the remaining region 4 strikes the step *3a*. In their end region, the parts 3 and 4 thus lie telescopically one inside the other.

In the present first illustrative embodiment, the remaining region 4 of the nozzle body 2 is composed of aluminum which is surface-anodized. This anodized layer *3b* forms the electrical insulation between the remaining region 4 and the tip region 3. The tip region 3 is manufactured from brass. Both parts 3 and 4 are bonded together firmly, more precisely by means of a very thin layer of a ceramic adhesive, this being particularly advantageous since this is very temperature-stable and, in addition, has an insulating effect.

The nozzle body 2 is mounted by its upper part in a sleeve-shaped element 6, and projects through a central opening 7 of the sleeve-shaped element 6 and is supported with an outer circumferential flange (not shown) in the interior of the sleeve-shaped element 6. In its upper part, the opening 7 in the sleeve-shaped element 6 is likewise of conical design, with the result that, in the upper region of the nozzle body 2, the outer circumferential face comes to rest on it. Thus, a centering of the nozzle body 2 relative to the sleeve-shaped element 6 is achieved. In its lower region facing the nozzle tip, the central opening 7 furthermore has a cylindrical shape, there being an internal thread 8 there.

In order to clamp the nozzle body 2 firmly in the sleeve-shaped element 6, a clamping element 9 is screwed into the sleeve-shaped element from the side opposite the nozzle tip. The clamping element comprises an inner body 10 and an outer body 11. The inner body 10 is composed, for example, of steel and, in its interior, is of conical design, such that the nozzle channel 5 is widened by it towards the upper end of the nozzle 1 when the clamping element 9 is connected to the sleeve-shaped element 6. In this state, the inner body 10 presses on the upper edge of the nozzle body 2 and thus prevents the nozzle body 2 from falling out of the sleeve-shaped element 6. The inner body 10 is here screwed to the sleeve-shaped element 6, for which purpose a threaded portion 12 on the outer circumferential edge of the inner body 10 engages in a corresponding internal thread of an axial bore in the upper region of the sleeve-shaped element 6.

The outer body 11 is situated above the threaded portion 12 and completely surrounds the inner body 10. Inner body 10 and outer body 11 can, for example, be bonded together, the outer body 11 being composed of electrically insulating material. The outer body 11, which is, for example, manufactured from plastic, has a cylindrical circumferential face which is coaxial to the central axis la of the nozzle 1 and bears an external thread 13. Via this external thread 13, the nozzle 1 can be screwed into a holder (not shown) of a material machining device. In this arrangement, the nozzle 1 is at the same time electrically insulated from the material machining device, this being due to the non-conducting properties of the outer body 11.

The sleeve-shaped element 6 furthermore has a radial through-channel 14 with an internal thread 15, it thus being possible to screw a connecting socket (not shown) into the radial through channel. The connecting socket has a central and insulated inner conductor and an outer conductor provided with an external thread, this external thread engaging in the internal thread 15 and being in electrical contact with the sleeve-shaped element 6. The connecting socket serves for the connection of a coaxial cable.

A nozzle electrode, which is composed, for example, of copper, bears the reference numeral 16. The nozzle electrode is of cylindrical design on the outside and has an outer circumferential flange 17. It is inserted into and fits in the cylindrical part of the tip region 3 and, with its outer circumferential flange 17, rests on the end face of the tip region 3. In this arrangement, a conical channel extending in the interior of the nozzle electrode 16 continues the nozzle channel 5 as far as the tip of the nozzle electrode 16. Starting from the upper edge of the clamping element 9, the nozzle channel 5 thus tapers uniformly as far as the tip end of the nozzle electrode 16 and makes a transition into an axial channel only in the last part, at the end face of the nozzle electrode 16.

The nozzle electrode 16 is in direct electrical contact with the tip region 3, with the result that both parts are at the same potential.

To secure the nozzle electrode 16 on the tip region 3, a cap element 18 is used, being designed in this case as a cap nut. The cap element 18 is likewise composed of electrically conducting material but is electrically insulated from the nozzle electrode 16. For this purpose, the cap element can carry an insulating layer 18A, for example a surface oxide layer, at least in the region of connection to the nozzle electrode 16. The cap element 18 can be manufactured from aluminum and the oxide or insulating layer would thus be an anodized layer.

One edge 19 of the cap element 18 engages behind the outer circumferential flange 17 of the nozzle electrode 16 and thus pulls the nozzle electrode 16 against the end face of the tip region 3 when the cap element 18 is screwed by an external thread directed towards the sleeve-shaped element 6 into the internal thread 8 of the central opening 7. During this process, the cap element 18 comes to lie at a distance from the nozzle body 2 and surrounds the latter completely.

On the one hand, as already mentioned, the cap element 18 and the sleeve-shaped element 6 are connected in electrically conducting fashion via the thread 8 and, on the other hand, the sleeve-shaped element 6 is connected in electrically conducting fashion to the remaining region 4 of the nozzle body 2 because both parts rest directly one upon the other and, in addition, are connected to one another electrically via the threaded portion 12 and the inner body 10.

In contrast, the tip region 3 and the nozzle electrode 16 are connected to one another in electrically conducting fashion. At the same time, however, the tip region 3 is electrically insulated from the remaining region 4 by the insulating layer lying between them, while the nozzle electrode 16 is electrically insulated from the cap element 18 by the surface coating of the cap element 18 in the connection region of the two parts.

In order to take off a sensor signal from the nozzle electrode 16 via the tip region 3, the tip region 3 is connected to an insulated wire (not shown) which passes through a region 20 between nozzle body 2 and cap element 18 or sleeve element 16 and is connected to the central conductor of the plug socket. The wire is therefore shielded by the cap element 18, the sleeve-shaped element 6 and the remaining region 4 of the nozzle body 2 while, on the other hand, the tip region 3 and a large part of the nozzle electrode 16 are likewise shielded by the cap element 18. Influencing of the sensor signal taken off at the nozzle electrode 16 by the material machining device into which the nozzle 1 is later screwed is likewise avoided because the remaining region 4 of the nozzle body 2 is also at shield potential.

FIG. 2 shows a second illustrative embodiment of the invention, in which there are modifications in the region of the nozzle electrode and of the cap element. Identical elements are provided with the same reference numerals and are not explained again. In FIG. 2, a nozzle electrode is provided with the reference numeral 16*a*, while a cap element bears the reference numeral 18*a* and is likewise designed as a cap nut. The nozzle electrode 16*a* here engages around the tip region 3 or the cylindrical part of the latter, an inner step 16*b* of the nozzle electrode 16*a* striking the end face of the tip region 3. An outer circumferential flange 17*a* is grasped by the claw-shaped tip region of the cap element 18*a*, with the result that the entire nozzle electrode 16*a* is pulled against the nozzle body 2 when the cap element 18*a* is screwed into the sleeve-shaped element 6. Here too, the nozzle electrode 16*a* is electrically insulated from the cap element 18*a*, more precisely by a corresponding insulating coating in the connection region of the two parts.

A higher or lower lateral sensitivity of the nozzle 1 can be obtained depending on whether the nozzle electrode 16 with the cap element 18 or the nozzle electrode 16*a* with the cap element 18*a* is used.

FIG. 3 shows a third illustrative embodiment in accordance with the invention, in which parts identical to those in FIGS. 1 and 2 are provided with the same reference numerals and are not described again in detail.

A nozzle in accordance with FIG. 3 again has the nozzle body 2 to which belong the tip region 3 and the remaining region 4 of the nozzle body 2. The nozzle body 2 is of cone-shaped design, both on the outside and on the inside. Only the free end of the tip region 3 has the hollow-cylinder shape, the nozzle channel 5 present in the interior of the nozzle body 2 tapering conically towards the tip of the nozzle 1 and finally making a transition into a cylindrical channel 5*a*.

As can be seen from FIG. 3, the tip region 3 and the remaining region 4 of the nozzle body 2 are inserted into and fit in one another and are insulated from one another, with the result that there is no electrically conducting connection between them. The step 3*a* on the outer circumferential edge of the tip region 3 serves for the axial positioning of the remaining region 4. The end face of the remaining region 4 strikes the step 3*a*. The parts 3 and 4 thus lie telescopically one inside the other.

In the present third illustrative embodiment, the remaining region 4 of the nozzle body 2 is composed of aluminium which is surface-anodized. This anodized layer forms the electrical insulation between the remaining region 4 and the tip region 3. The tip region 3 is manufactured from brass. Both parts 3 and 4 are bonded together firmly, more precisely by means of a very thin layer of a ceramic adhesive, this being particularly advantageous since this is very temperature-stable and, in addition, has an electrically insulating effect.

The nozzle body 2 is mounted in a sleeve-shaped element 21 (sleeve), and more precisely is centered relative to the latter. Here, the remaining region 4 rests with a shoulder 22 on a projection 23 of the sleeve-shaped element 21 (sleeve). A top part 24 with an internal taper and an external thread is screwed into the upper region of the sleeve-shaped element 21 and presses the shoulder 22 against the projection 23.

The sleeve-shaped element 21 is composed, for example, of aluminum and is in electrical contact with the remaining region 4 of the nozzle body 2. Shield potential comes to be applied to both elements 4 and 21, more precisely via the shielded lead of a plug which is received in a plug socket 25 which is attached to the outer circumferential edge of the sleeve-shaped element 21. A signal lead 26 of the plug socket 25 is electrically connected to the tip region 3 of the nozzle body 2. The signal lead 26 extends in the space between elements 4 and 21. In the present case, the sleeve-shaped element 21 is taken such a distance towards the nozzle tip that it very largely covers the tip region 3 of the nozzle body 2.

As already mentioned, the tip region 3 has the cylindrical channel 5*a*, in which there is an internal thread 27. Screwed into this internal thread 27 by a corresponding external thread is a nozzle electrode 28 which is in direct electrical contact with the tip region 3. The nozzle electrode 28 is manufactured from electrically conducting material, for example from copper, and, in the present case, has a conical shape. However, it can also be of cylindrical design on the outside. An inner channel 29 of the nozzle electrode 28 is chosen in such a way that it continues the channel 5 conically virtually as far as the tip of the nozzle electrode 28.

The sleeve-shaped element 21, which serves to shield the nozzle body 2, extends virtually as far as the end face of the tip region 3 and there likewise has a cylindrical channel, in which there is an internal thread 30. Screwed into this internal thread 30 by a corresponding external thread is a shielding sleeve 31 which projects forwards beyond the tip region 3 and also partially engages around a foot part of the nozzle electrode 28 circumferentially. The shielding sleeve

31 is in direct electrical contact with the sleeve-shaped element 21, with the result that it too comes to be at shield potential. By means of the shielding sleeve 31, the upper part of the nozzle electrode 28 is in practice also shielded. To be more precise, the threaded region of the shielding sleeve 31 comes to lie between the sleeve-shaped element 21 and the tip region 3, the shielding sleeve 31 extending further, beyond the frontal edge region of the tip region 3. It can also cover or shield the nozzle electrode 28 for a greater distance than shown in the direction of the nozzle tip.

The shielding sleeve 31 is preferably provided with an electrically insulating surface coating, except in its threaded portion, since an electrically conducting connection to the sleeve-shaped element 21 must be established there. The surface coating can, for example, be an oxide layer or anodized layer if the shielding sleeve 31 is manufactured from an appropriate metal. Otherwise, it is electrically insulated from the tip region 3 and the nozzle electrode 28 so that it also is possible to establish a mechanical contact between these elements in order to obtain a structural stiffening in the region of the nozzle tip.

In the present illustrative embodiment, the nozzle electrode 28 is provided with a circumferential bead 32 which covers the frontal region of the shielding sleeve 31 and thus protects it from metal spatter which occurs under certain circumstances when working a workpiece, e.g. during welding. In particular, the circumferential bead 32 prevents such metal spatter from entering the region between the nozzle electrode 28 and the shielding sleeve 31 and thus causing damage there. Since the shielding sleeve 31 bears an electrically insulating surface coating, it is virtually impossible for metal spatter in the-region between the shielding sleeve 31 and the nozzle electrode 28 to lead to short circuits.

The nozzle electrode 28 can be unscrewed from the tip region 3 in a simple manner without the necessity of detaching other parts for this purpose. It can thus easily be replaced by another one. If matching of the geometry of the shielding sleeve 31 is necessary in this context, the shielding sleeve 28 can likewise easily be unscrewed from the sleeve-shaped element 21 and replaced by another suitable one. The shielding sleeve 31 and the nozzle electrode 28 can thus be exchanged very rapidly, leading to better availability of the nozzle.

A fourth illustrative embodiment of a nozzle in accordance with the invention is depicted in FIG. 4. Identical elements to those in FIG. 1 are here provided with the same reference numerals. They are not described again.

As a modification to the illustrative embodiment in accordance with FIG. 3, a nozzle electrode 33 is here placed directly on the end face of the tip region 3 without being connected directly to the latter. On the contrary, the nozzle electrode 33 has a projection 34 (foot part) with an external thread 35 which is screwed into an internal thread 36 of a shielding sleeve 37 which, for its part, is screwed by a corresponding external thread into the internal thread 30 of the sleeve-shaped element 21, which, in this case, extends, for example, only as far as the frontal edge of the remaining region 4.

The nozzle electrode 33 is in electrical contact with the tip region 3, which, for its part, is connected via a shielded or insulated lead (not shown) to the signal terminal of a plug socket (not shown). A sensor signal is thus conducted from the nozzle electrode 33, via the tip region 3 and the head, to the signal terminal of the plug socket. The nozzle electrode 33, on the other hand, is electrically insulated from the shielding sleeve 37, for which purpose the shielding sleeve

37 can be provided in the region of the internal thread 36 with an electrically insulating surface coating, for example with an oxide layer. The shielding sleeve 37 is electrically connected to the sleeve-shaped element 21, with the result that the shield potential also reaches the shielding sleeve 37 which surrounds the tip region 3.

A circumferential bead 38 of the nozzle electrode 33 serves to protect the shielding sleeve 37 against metal spatter, which can arise during the working operation. If such metal spatter nevertheless gets behind the circumferential bead 38, this cannot lead to short circuits in the region between the shielding sleeve 37 and the nozzle electrode 33 if the shielding sleeve 37 is also provided with an insulating surface coating in its remaining or outer region.

While the invention has been illustrated and described as embodied in a nozzle for a tool for the working of material, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. A nozzle for a tool for working of material, comprising a nozzle body composed of electrically conductive material, the nozzle body having a tip region that carries a nozzle electrode, the tip region of the nozzle body and a remaining region of the nozzle body being formed by separate parts; the nozzle electrode being in direct contact with the tip region, and the tip region being electrically insulated from and fixed to the remaining region of the nozzle body by an electrically insulating adhesive.

2. The nozzle as claimed in claim 1, wherein the adhesive is a ceramic adhesive.

3. The nozzle as claimed in claim 1, wherein the remaining region, the tip region and a nozzle body part, are insertable into one another at an end face.

4. The nozzle as claimed in claim 3, wherein the remaining region, the tip region and the nozzle-body part, have steps (*3a*) at their circumferential edges for mutual positioning in an axial direction.

5. A nozzle for a tool for working of material, comprising a nozzle body composed of electrically conductive material, the nozzle body having a tip region that carries a nozzle electrode, the tip region of the nozzle body and a remaining region of the nozzle body being formed by separate parts;

the nozzle electrode being in direct contact with the tip region, and the tip region being electrically insulated from the remaining region of the nozzle body, wherein at least one of the remaining region of the nozzle body and the tip region have an electrically insulating surface coating, at least in a region of connection of the two.

6. The nozzle as claimed in claim 5, wherein the electrically insulating surface coating is one of an oxide, an anodized and a ceramic coating.

7. A nozzle for a tool for working of material, comprising a nozzle body composed of electrically conductive material, the nozzle body having a tip region that carries a nozzle electrode, the tip region of the nozzle body and a remaining region of the nozzle body being formed by separate parts;

the nozzle electrode being in direct contact with the tip region, and the tip region being electrically insulated from the remaining region of the nozzle body, the nozzle further comprising a cap element that accommodates and holds the nozzle electrode, the cap element being composed of an electrically conducting material and being electrically insulated from the nozzle electrode.

8. The nozzle as claimed in claim 7, wherein the cap element is connectable to a sleeve of electrically conducting material which surrounds the nozzle body and via which the cap element is in electrical contact with the remaining region of the nozzle body.

9. The nozzle as claimed in claim 8, wherein, at least in a region of contact with the nozzle electrode, the cap element bears an electrically insulating surface coating.

10. The nozzle as claimed in claim 9, wherein the surface coating is one of an oxide, an anodized and a ceramic coating.

11. The nozzle as claimed in claim 8, wherein the cap element has cap nut which is screwed to the sleeve.

12. The nozzle as claimed in claim 7, wherein, at least in a region of contact with the nozzle electrode the cap element bears an electrically insulating surface coating.

13. The nozzle as claimed in claim 12, wherein the surface coating is one of an oxide, an anodized and a ceramic coating.

14. The nozzle as claimed in claim 7, wherein the nozzle electrode has an outer circumferential flange and is inserted into the tip region so as to rest on an end face of the tip region by means of the outer circumferential flange.

15. The nozzle as claimed in claim 14, wherein the cap element is provided so as to pull the nozzle electrode against the tip region via the circumferential flange.

16. The nozzle as claimed in claim 7, wherein the nozzle electrode has a circumferential flange that engages around the tip region so as to rest on the end face of the tip region by means of an inner step of the nozzle electrode.

17. The nozzle as claimed in claim 16, wherein the cap element is provided so as to pull the nozzle electrode against the tip region via the circumferential flange.

18. The nozzle as claimed in claim 7, wherein the nozzle electrode has an external conical shape and the cap element has a corresponding inner conical shape.

19. A nozzle for a tool for working of material, comprising a nozzle body composed of electrically conductive material, the nozzle body having a tip region that carries a nozzle electrode, the tip region of the nozzle body and a remaining region of the nozzle body being formed by separate parts, the nozzle electrode being in direct contact with the tip region, and the tip region being electrically insulated from the remaining region of the nozzle body;

wherein the nozzle body is surrounded by a sleeve of electrically conducting material which lies at a distance from the nozzle body and is in electrical contact with the remaining region of the nozzle body;

wherein the sleeve carries at its tip a removable shielding sleeve which is in electrical contact with the sleeve and at least partially surrounds a nozzle electrode, the shielding sleeve being composed of electrically conducting material and electrically insulated from the nozzle electrode; and

wherein the nozzle electrode is connected directly to the tip region of the nozzle body.

20. The nozzle as claimed in claim 19, wherein the nozzle electrode is screwed into the tip region of the nozzle body.

21. The nozzle as claimed in claim 19, wherein the nozzle electrode and the tip region of the nozzle body are connected to one another by a bayonet catch.

22. The nozzle as claimed in claim 19, wherein the nozzle electrode and the tip region of the nozzle body are connected to one another by a lock-in catch.

23. The nozzle as claimed in claim 19, wherein the nozzle electrode has a circumferential boad that covers a frontal edge of the shielding sleeve.

24. A nozzle for a tool for working of material, comprising a nozzle body composed of electrically conductive material, the nozzle body having a tip region that carries a nozzle electrode, the tip region of the nozzle body and a remaining region of the nozzle body being formed by separate parts;

wherein the nozzle electrode being in direct contact with the tip region, and the tip region being electrically insulated from the remaining region of the nozzle body;

wherein the nozzle body is surrounded by a sleeve of electrically conducting material which lies at a distance from the nozzle body and is in electrical contact with the remaining region of the nozzle body;

wherein the sleeve carries at its tip a removable shielding sleeve which is in electrical contact with the sleeve and at least partially surrounds the nozzle electrode, the shielding sleeve being composed of electrically conducting material and electrically insulated fro the nozzle electrode; and

wherein the nozzle electrode has a foot part, by which the nozzle electrode is introducible from the outside into the shielding sleeve and connected thereto.

25. The nozzle as claimed in claim 24, wherein the foot part can be screwed into the shielding sleeve.

26. The nozzle as claimed in claim 24, wherein the shielding sleeve is screwed to the sleeve.

27. The nozzle as claimed in claim 24, wherein the shielding sleeve bears an electrically insulating surface coating at least in a region of contact with the nozzle electrode.

28. The nozzle as claimed in claim 27, wherein the surface coating is one of an oxide, ananodized and a ceramic coating.

29. The nozzle as claimed in claim 24, wherein the nozzle electrode has a circumferential boad that covers a frontal edge of the shielding sleeve.

* * * * *

ORIGINAL

CIVIL COVER SHEET COUNTY IN WHICH THIS ACTION AROSE:

JS-44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of the court. This form, approved by the Judicial Conference of the United States in September, 1974, is required for the use of the Clerk of the Court for the purpose of initiating the civil docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THIS FORM.)

05-60182

I.(a) PLAINTIFF
Precitec, Inc.

DEFENDANT
American Torch Tip, Ltd.

(b) COUNTY OF RESIDENCE OF FIRST LISTED PLAINTIFF
OAKLAND
(EXCEPT IN U.S. PLAINTIFF CASES)

COUNTY OF RESIDENCE OF FIRST LISTED DEFENDANT:
(IN U.S. PLAINTIFF CASES ONLY)
Note: In land condemnation cases, use the location of the tract of land involved

(c) ATTORNEYS (FIRM NAME, ADDRESS AND TELEPHONE NUMBER)
R. Terrance Rader (P28747), Charles A. Bieneman (P66755), and Linda D. Kennedy (P64692)
RADER, FISHMAN & GRAUER, PLLC
39533 Woodward Avenue, Suite 140
Bloomfield Hills, Michigan 48304
(248) 594-0600

ATTORNEYS (IF KNOWN)

JOHN CORBETT O'MEARA

MAGISTRATE JUDGE R. STEVEN WHALEN

II. BASIS OF JURISDICTION (Place an "X" in one box only)

- ☐ 1. U. S. Government Plaintiff
- ☐ 2. U. S. Government Defendant
- ☒ 3. Federal Question (U.S. Government not a party)
- ☐ 4. Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (place an "x" in one box for plaintiff and one box for defendant)

(For Diversity Cases only)

	PTF	DEF		PTF	DEF
Citizen of this State	☐ 1	☐ 1	Inc. or Principal Place of business in this State	☐ 4	☐ 4
Citizen of another State	☐ 2	☐ 2	Inc. & Principal place of business in another State	☐ 5	☐ 5
Citizen or subject of a Foreign country	☐ 3	☐ 3	Foreign Nation	☐ 6	☐ 6

IV. ORIGIN (PLACE AN "X" IN ONE BOX ONLY)

☒ 1 Original Proceeding ☐ 2 Removed to State Court ☐ 3 Remanded from Appellate Court ☐ 4 Reinstated or Reopened ☐ 5 Transferred from another district (specify) ☐ 6 Multidistrict Litigation ☐ 7 Appeal to District Judge from Magistrate Judgment

V. NATURE OF SUIT (PLACE AN "X" IN ONE BOX ONLY)

CONTRACT
☐ 110 Insurance
☐ 120 Marine
☐ 130 Miller Act
☐ 140 Negotiable Instrument
☐ 150 Recov. Of Overpayment & Enforcement of Judgment
☐ 151 Medicare Act
☐ 152 Recovery of Defaulted Student Loans (Exc. Veterans)
☐ 153 Recov. Of Overpayment of Veteran's Benefits
☐ 160 Stockholders' Suits
☐ 190 Other Contract
☐ 195 Contract Product Liab.

REAL PROPERTY
☐ 210 Land Condemnation
☐ 220 Foreclosure
☐ 230 Rent Lease & Ejectment
☐ 240 Torts
☐ 245 Tort Product Liability
☐ 290 All Other Real Property

TORTS

PERSONAL INJURY
☐ 310 Airplane
☐ 315 Airplane Product Liability
☐ 320 Assault, Libel & Slander
☐ 330 Federal Employer Liability
☐ 340 Marine
☐ 345 Marine Product Liability
☐ 350 Motor Vehicle
☐ 355 Motor Vehicle Product Liability
☐ 360 Other Pers. Inj.

PERSONAL INJURY
☐ 362 Personal Injury - Med. Malpractice
☐ 365 Personal Injury - Product Liability
☐ 368 Asbestos Personal Injury Prod. Liab.

PERSONAL PROPERTY
☐ 370 Other Fraud
☐ 371 Truth in Lending
☐ 380 Other Personal Property Damage
☐ 385 Property Damage Product Liability

CIVIL RIGHTS
☐ 441 Voting
☐ 442 Employment
☐ 443 Housing/ Accommodations
☐ 444 Welfare
☐ 440 Other Civil Rights

PRISONER PETITIONS
☐ 510 Motions to Vacate Sentence
HABEAS CORPUS
☐ 530 General
☐ 535 Death Penalty
☐ 540 Mandamus & Other
☐ 550 Civil Rights
☐ 555 Prison Condition

FORFEITURE/PENALTY
☐ 610 Agriculture
☐ 620 Other Food & Drug
☐ 625 Drug Related Seizure of property 21 USC 881
☐ 630 Liquor Laws
☐ 640 R. R. & Truck
☐ 650 Airline Regs.
☐ 660 Occupational Safety/Health
☐ 690 Other

LABOR
☐ 710 Fair Labor Standards Act
☐ 720 Labor/Mgmt. Relation
☐ 730 Labor/Mgmt. Report. & Disclosure Act
☐ 740 Railway Labor Act
☐ 790 Other Labor Litigation
☐ 791 Empl. Ret. Inc. Security Act

BANKRUPTCY
☐ 422 App. 28 USC 158
☐ 423 Withdrawal

PROPERTY RIGHTS
☐ ~~820 Copyrights~~
☒ 830 Patent
☐ ~~840 Trademark~~

SOCIAL SECURITY
☐ 861 HIA (1395ff)
☐ 862 Black Lung (923)
☐ 863 DIWC/DIWW
☐ 864 SSID Title XVI
☐ 865 RSI (405 (g))

FEDERAL TAX SUITS
☐ 870 Taxes (U.S. Plaint or Defendant)
☐ 871 IRS - Third Party 28 USC 7609

OTHER STATUTES
☐ 400 State Reapportion.
☐ 410 Antitrust
☐ 430 Banks and Banking
☐ 450 Commerce/ICCRates.
☐ 460 Deportation
☐ 470 Racketeer Influenced& Corrupt Organizations
☐ 810 Selective Service
☐ 850 Securities/Commodity Exchange
☐ 875 Customer Challenge 12 USC 3410
☐ 891 Agricultural Acts
☐ 892 Economic Stabiliz. Act
☐ 893 Environmental Matters
☐ 894 Energy Allocation Act
☐ 895 Freedom of Information Act
☐ 900 Appeal of Fee Determ. Under Equal Access to Just.
☐ 950 Constitutionality of State Statutes
☐ 990 Other Statutory Action

VI. CAUSE OF ACTION (CITE THE U.S. CIVIL STATUTE UNDER WHICH YOU ARE FILING AND WRITE BRIEF STATEMENT OF CAUSE. DO NOT CITE JURISDICTIONAL STATUTES UNLESS DIVERSITY)

Patent infringement under 35 U.S.C.; 28 U.S.C. §§ 1331 AND 1338(a); 28 U.S.C. § 1332

VII. REQUESTED IN COMPLAINT:

Check if this is a CLASS ACTION ☐ Under F.R.C. 23

DEMAND
Injunctive and other relief
$

CHECK YES only if demanded in complaint
JURY DEMAND ☒ Yes ☐ No

VIII. RELATED CASE(S) (See Instructions)

IF ANY - None

JUDGE
Nancy Edmonds

Docket Number
02-CV-72923

Date: August 1, 2005

By: Charles A. Bieneman (P66755)

FOR OFFICE USE ONLY

PURSUANT TO LOCAL RULE 83.11

1. Is this a case that has been previously discontinued or dismissed?

☐ YES ☒ NO

If **yes**, give the following information:

Court: ______________________

Case No: ______________________

Judge: ______________________

2. Other than stated above, are there any pending or previously discontinued or dismissed companion cases in this or any other court, including state court? (Companion cases are matters in which it appears substantially similar evidence will be offered or the same or related parties are present and the cases arise out of the same transaction or occurrence.)

☒ YES ☐ NO

Court: U.S. District Court, Eastern District of Michigan

Case No: 02-CV-72923

Judge: Honorable Nancy Edmunds

NOTES:

R0305540.DOC